Frame Relay

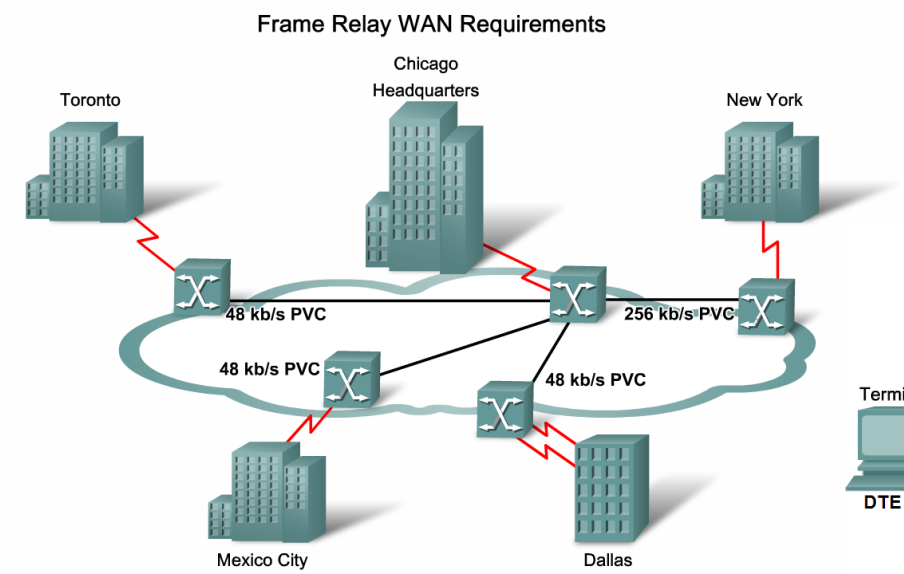
Accessing the WAN – Chapter 3

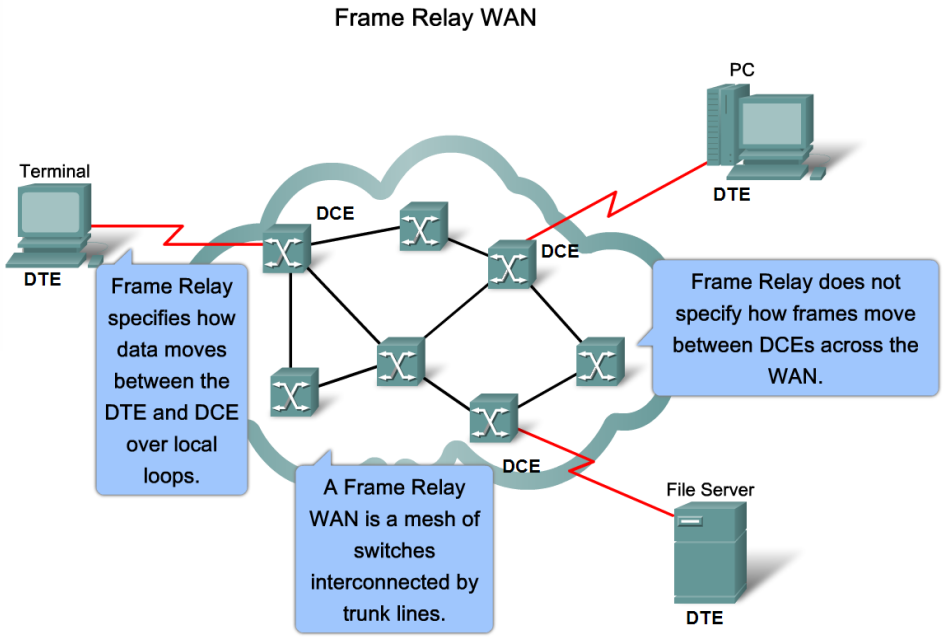
Objectives

- Describe the fundamental concepts of Frame Relay technology in terms of Enterprise WAN services including Frame Relay operation, Frame Relay implementation requirements, Frame Relay maps, and LMI operation.
- Configure a basic Frame Relay PVC including configuring and troubleshooting Frame Relay on a router serial interface and configuring a static Frame Relay map.
- Describe advanced concepts of Frame Relay technology in terms of Enterprise WAN services including Frame Relay sub-interfaces, Frame Relay bandwidth and flow control.
- Configure an advanced Frame Relay PVC including solving reachability issues, configuring Frame Relay sub-interfaces, verifying and troubleshooting Frame Relay configuration.

Describe the Fundamental Concepts of Frame Relay Technology

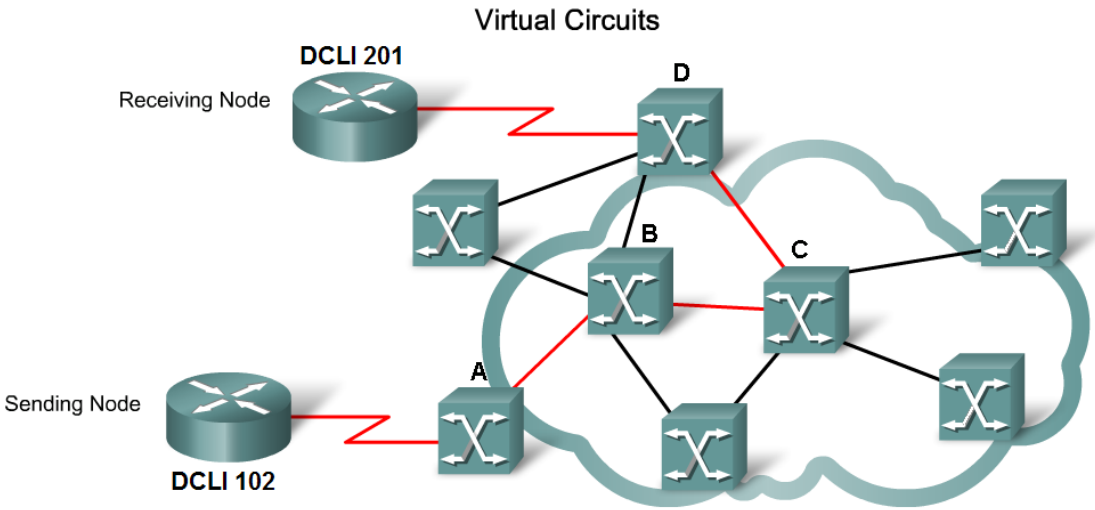
- Describe how Frame Relay is used to provide WAN services to the Enterprise

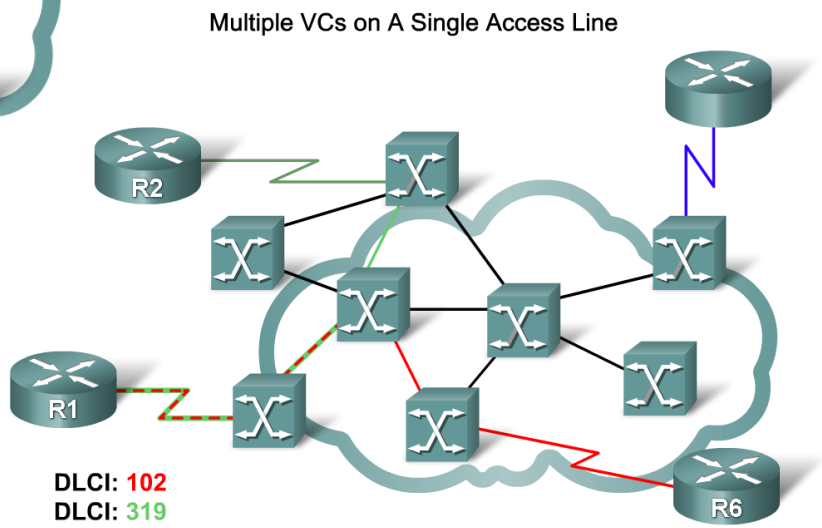




Describe the Fundamental Concepts of Frame Relay Technology

- Describe how Frame Relay uses virtual circuits to carry packets from one DTE to another

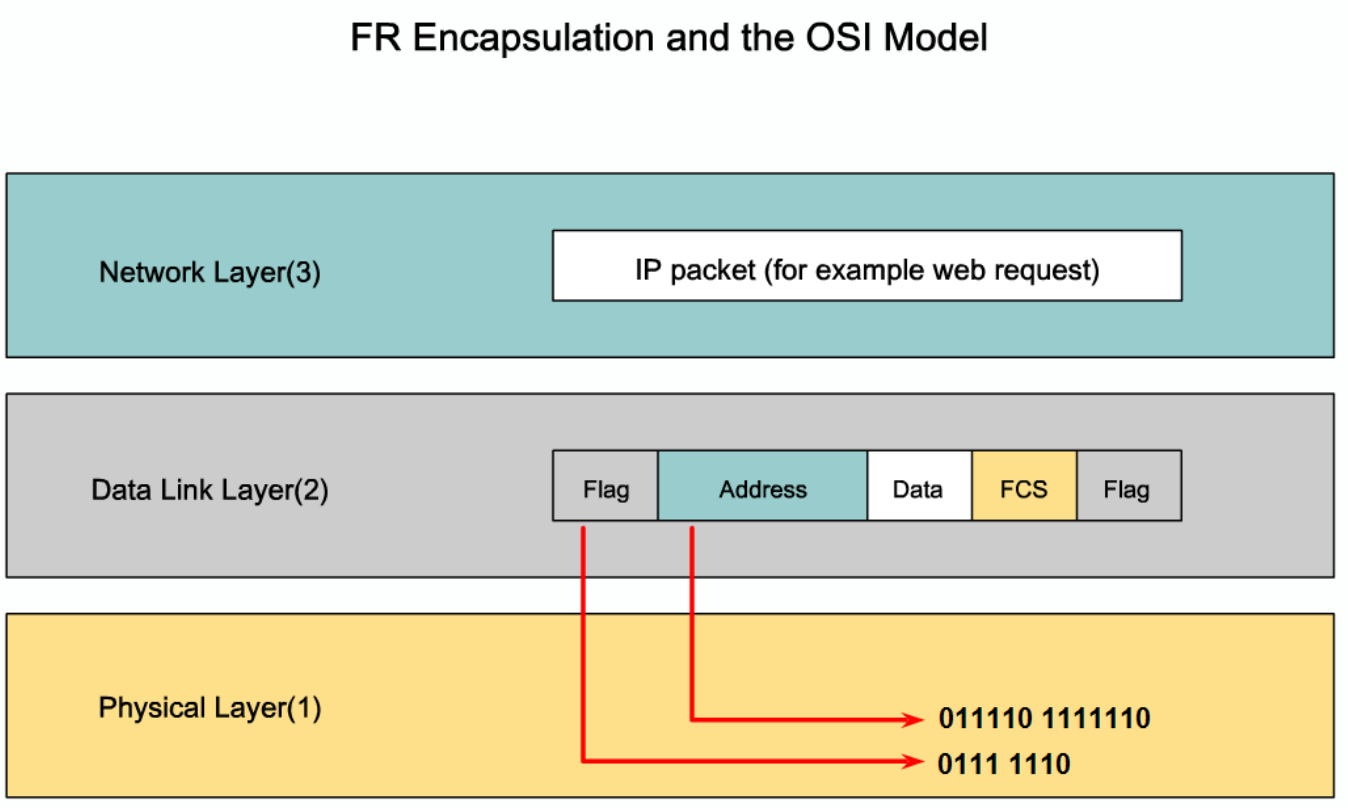




Multiple VCs on the same access link are distinguishable by the DLCI.

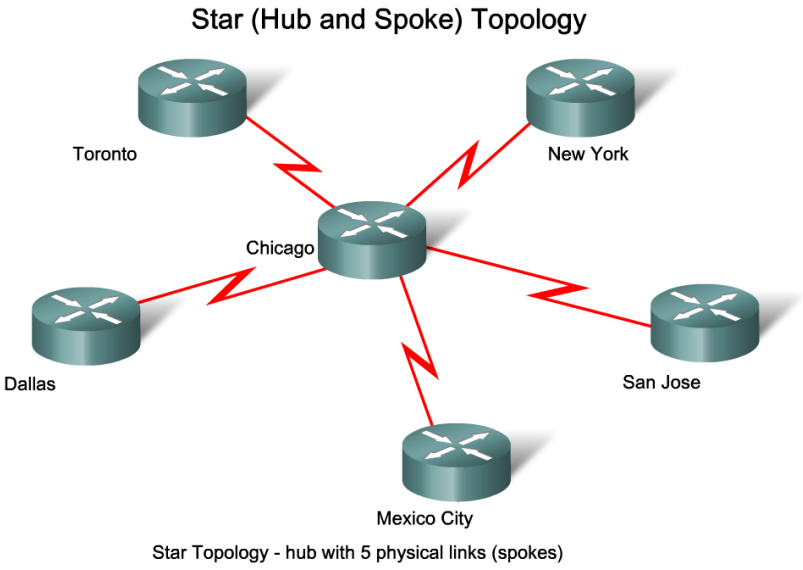
Describe the Fundamental Concepts of Frame Relay Technology

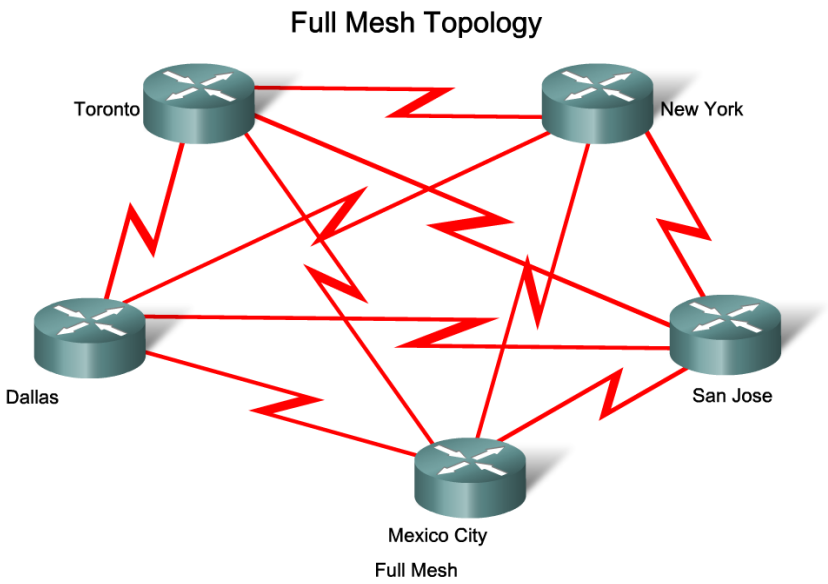
- Explain how Frame Relay encapsulation works



Describe the Fundamental Concepts of Frame Relay Technology

- Describe the types of topologies that are used for implementing Frame Relay in different environments



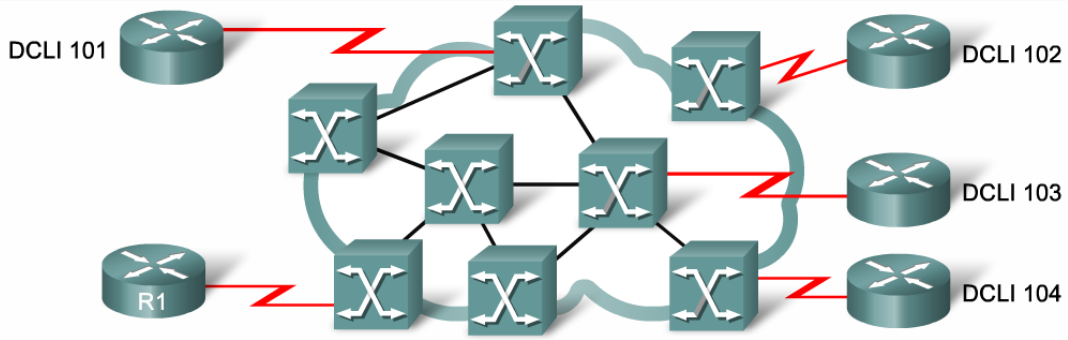


Describe the Fundamental Concepts of Frame Relay Technology

- Describe how a router attached to a Frame Relay network uses LMI status messages and inverse ARP queries to map VCs to layer 3 network IP Addresses

Stages of Inverse ARP and LMI Operation

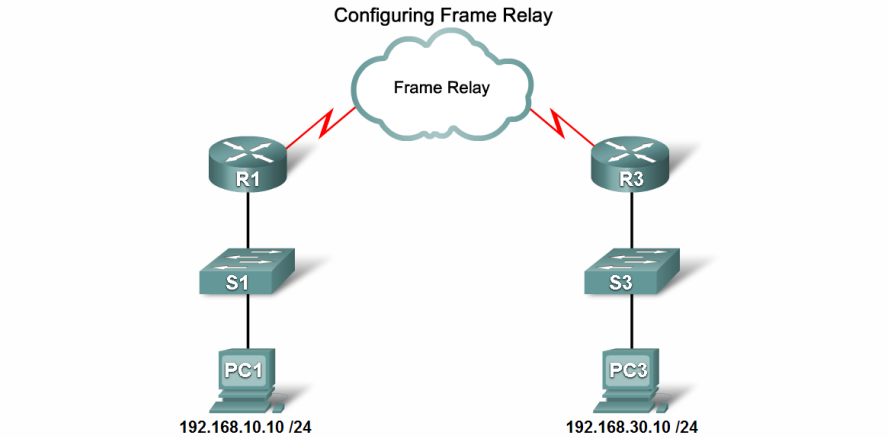
DTE sends Status Enquiry Message (75) to DCE
DCE responds with Status Message (7D) - includes configured DLCIs
DTE learns what VCs it has



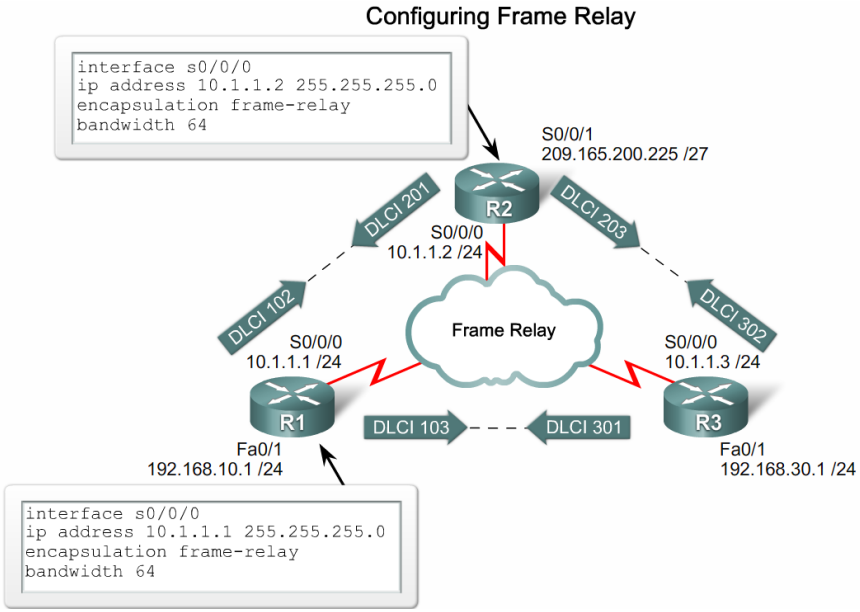
DLCI	Status
101	Active
102	Active
103	Active
104	Active

Configure a Basic Frame Relay PVC

- Configure a basic Frame Relay PVC on a router serial interface

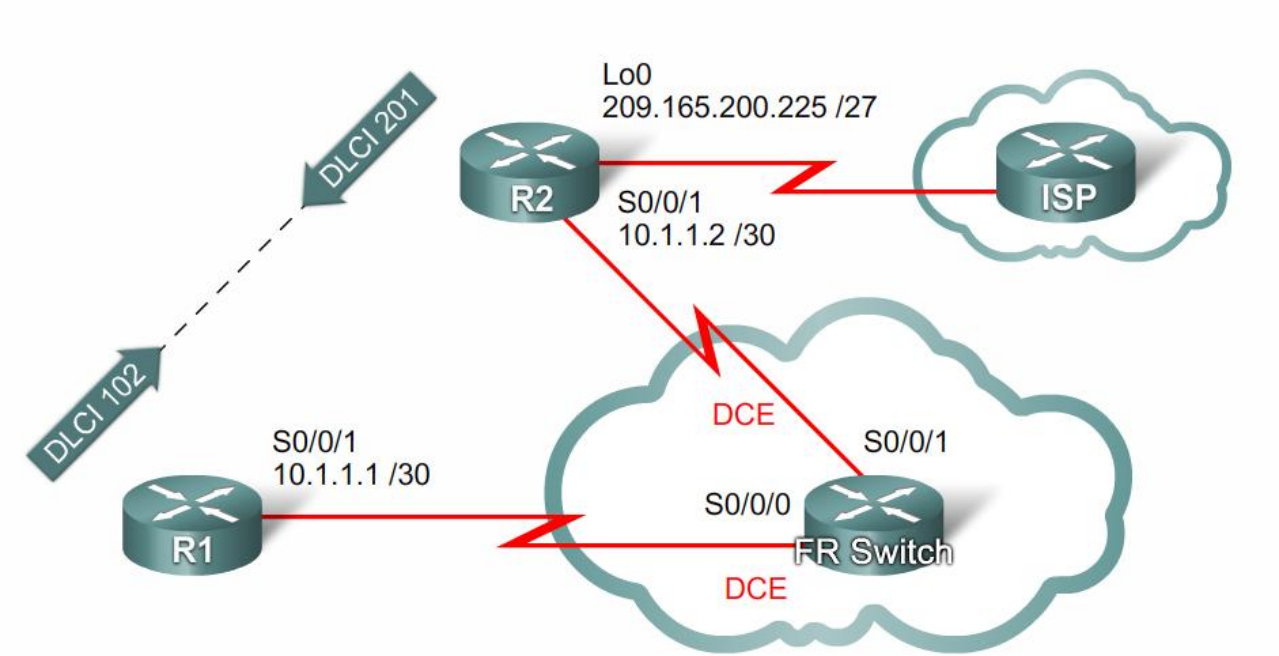


Required Tasks	Optional Tasks
• Enable Frame Relay encapsulation on an interface • Configure dynamic or static address mapping	• Configure the LMI • Configure Frame Relay SVCs • Configure Frame Relay traffic shaping • Customize Frame Relay for your network • Monitor and Maintain Frame Relay connections



Configure a Basic Frame Relay PVC

- Configure a static Frame Relay map

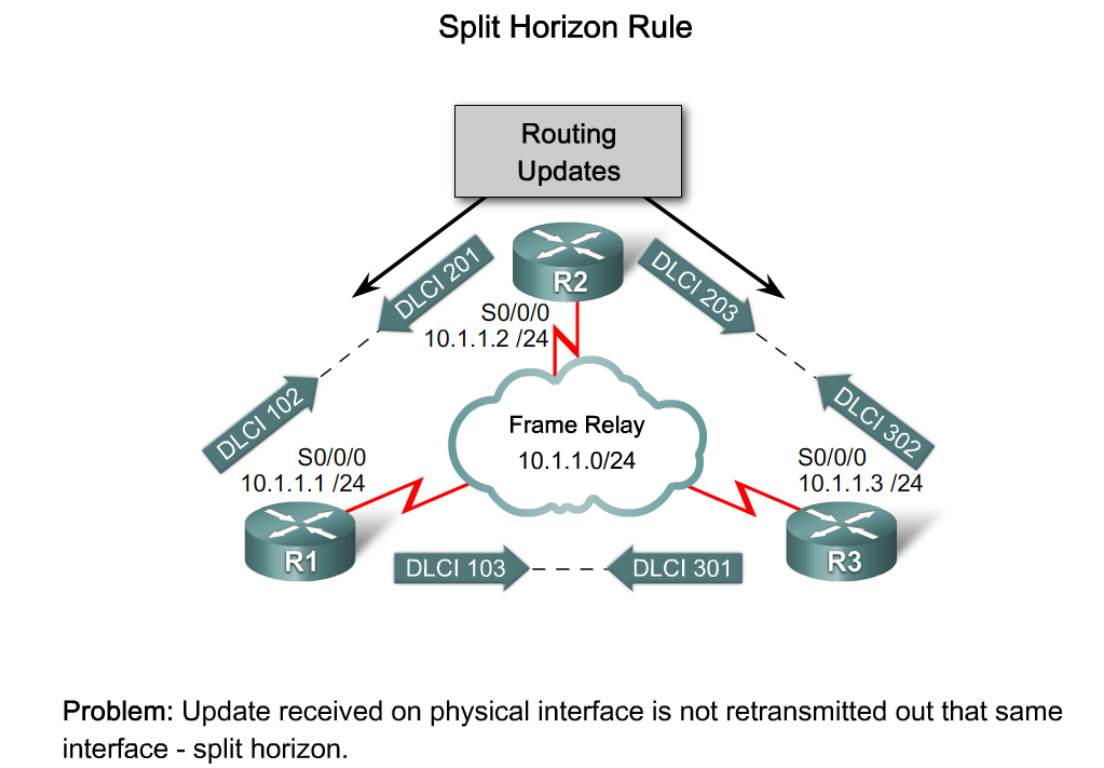


Configuration for R1

```
interface s0/0/1
ip address 10.1.1.1 255.255.255.252
encapsulation frame-relay
bandwidth 64
frame-relay map ip 10.1.1.2 102 broadcast
```

Describe Advanced Concepts of Frame Relay Technology

- Explain the reachability issues associated with the Frame Relay NBMA topology



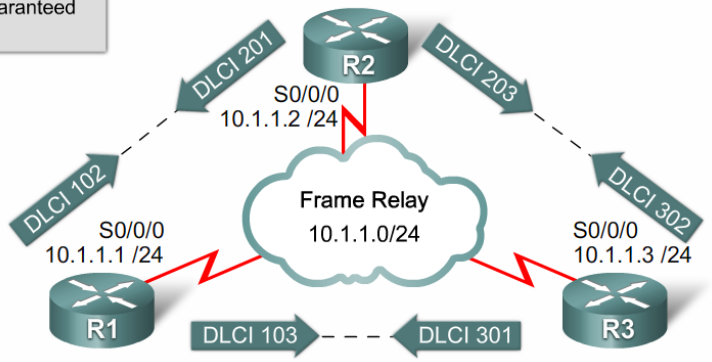
Describe Advanced Concepts of Frame Relay Technology

- Describe how to implement bandwidth control in the Frame Relay technology

Paying for Frame Relay

Term	Access
Access Rate or Port Speed	The capacity of the local loop
Committed Information Rate (CIR)	The capacity through the local loop guaranteed by the provider

Frame Relay Bursting

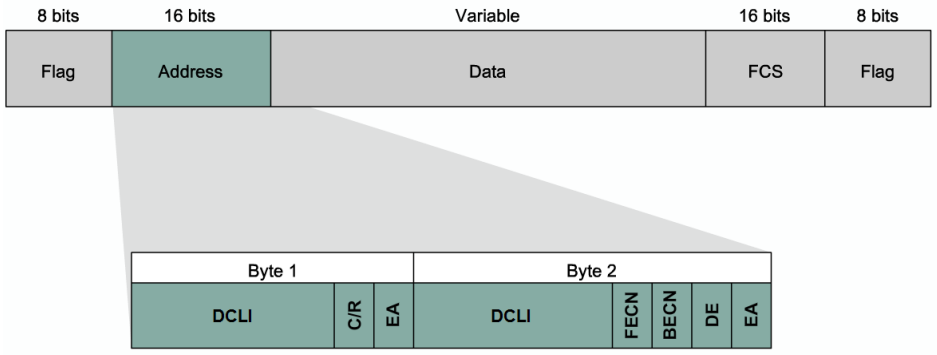


PVC DCLI	CIR (Normal)	CBIR (example)	BE
DCLI 102	32 kb/s	48 kb/s	16 kb/s
DCLI 103	16 kb/s	0 kb/s	48 kb/s
	All frames are forwarded	Frames are forwarded but marked DE	Frames will most likely will be dropped

Describe Advanced Concepts of Frame Relay Technology

- Describe how to implement flow control in Frame Relay technology

Standard Frame Relay Frame

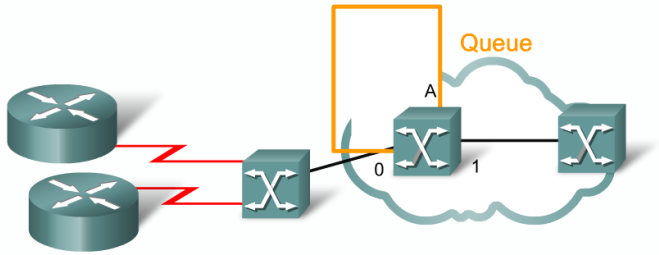


FR Bandwidth Control: Queuing

While switch A is putting a large frame on interface 1, other frames for this interface are queued.

Downstream devices are warned of the queue by setting the FECN bit

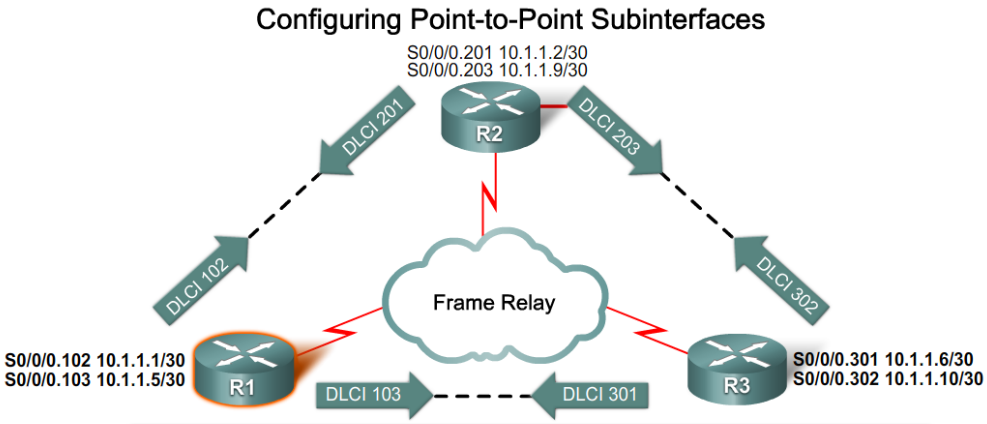
Upstream devices are warned of the queue by setting the BECN bit- even though they may not have contributed to the congestion



While switch A is putting a large frame on interface 1, other frames for this interface are queued.

Configure an Advanced Frame Relay PVC

- Explain the steps to configure point-to-point subinterfaces on a physical interface




```
interface s0/0/0
 no ip address
 encapsulation frame-relay
 no shut
exit

interface s0/0/0.102 point-to-point
 ip address 10.1.1.1 255.255.255.252
 bandwidth 64
 frame-relay interface-dlci 102
exit

interface s0/0/0.103 point-to-point
 ip address 10.1.1.5 255.255.255.252
```

Configure an Advanced Frame Relay PVC

- Describe the commands used for verifying Frame Relay operation

Verifying Frame Relay Operation: Look at the Interfaces

```
R1#show interface serial 0/0/1
Serial0/0/1 is up, line protocol is up
  Hardware is GT96K Serial
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation FRAME-RELAY, loopback not set
  Keepalive set (10 sec)
  CRC checking enabled
  LMI enq sent  59, LMI stat recvd 59, LMI upd recvd 0, DTE LMI up
  LMI enq recvd 0, LMI stat sent  0, LMI upd sent  0
  LMI DLCI 1023  LMI type is CISCO  frame relay DTE
  FR SVC disabled, LAPF state down
  Broadcast queue 0/64, broadcasts sent/dropped 11/0, interface broadcasts 0
  Last input 00:00:05, output 00:00:05, output hang never
  Last clearing of "show interface" counters 00:09:55
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 1158 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     67 packets input, 2367 bytes, 0 no buffer
```

Configure an Advanced Frame Relay PVC

- Describe the steps for troubleshooting a Frame Relay configuration

Troubleshooting Frame Relay Operation

```
R1#debug frame-relay lmi
Frame Relay LMI debugging is on
Displaying all Frame Relay LMI data
R1#
*Sep 12 00:09:35.425: Serial0/0/1(out): StEnq, myseq 110, yourseen 109, DTE up
*Sep 12 00:09:35.425: datagramstart = 0x3F4055D4, datagramsize = 13
*Sep 12 00:09:35.425: FR encap = 0xFCF10309
*Sep 12 00:09:35.425: 00 75 01 01 01 03 02 6E 6D
*Sep 12 00:09:35.425:
*Sep 12 00:09:35.425: Serial0/0/1(in): Status, myseq 110, pak size 13
*Sep 12 00:09:35.425: RT IE 1, length 1, type 1
*Sep 12 00:09:35.425: KA IE 3, length 2, yourseq 110, myseq 110
R1#
*Sep 12 00:09:45.425: Serial0/0/1(out): StEnq, myseq 111, yourseen 110, DTE up
*Sep 12 00:09:45.425: datagramstart = 0x3F4050D4, datagramsize = 13
*Sep 12 00:09:45.425: FR encap = 0xFCF10309
*Sep 12 00:09:45.425: 00 75 01 01 01 03 02 6F 6E
*Sep 12 00:09:45.425:
*Sep 12 00:09:45.425: Serial0/0/1(in): Status, myseq 111, pak size 13
*Sep 12 00:09:45.425: RT IE 1, length 1, type 1
*Sep 12 00:09:45.425: KA IE 3, length 2, yourseq 111, myseq 111
R1#undebug all
All possible debugging has been turned off
R1#
-----------------------------------------
R2#debug frame-relay lmi
Frame Relay LMI debugging is on
```

Summary

- Frame relay is the most widely used WAN technology because it:
  - –Provides greater bandwidth than leased line
  - –Reduces cost because it uses less equipment
  - –Easy to implement
- Frame relay is associated with layer 2 of the OSI model and encapsulates data packets in a frame relay frame
- Frame relay is configured on virtual circuits
  - –These virtual circuits may be identified by a DLCI
- Frame relay uses inverse ARP to map DLCI to IP addresses

Summary

- Configuring frame relay requires
  - –Enable frame relay encapsulation
  - –Configuring either static or dynamic mapping
  - –Considering split horizon problems that develop when multiple VCs are placed on a single physical interface
- Factor affecting frame relay configuration
  - –How service provider has their charging scheme set up
- Frame relay flow control
  - –DE
  - –FECN
  - –BECN

Summary

- The following commands can be used to help verify frame relay configuration
  - –Show interfaces
  - –Show frame-relay lmi
  - –Show frame-relay pvc ###
  - –Show frame-relay map
- Use the following command to help troubleshoot a frame relay configuration
  - –Debug frame-relay lmi